Nanotechnology 2011 vol.22 N2

Near-field optical taper antennas fabricated with a highly replicable ac electrochemical etching method

Kharintsev S., Noskov A., Hoffmann G., Loos J.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

This paper describes a novel chemical etching method to fabricate high quality near-field optical antennas-tapered metallic tips-from gold wire in a reproducible way for optically probing a specimen on the nanoscale. A new type of an electrochemical cell is introduced and different dc and ac etching regimes are studied in detail. The formation and dynamics of a meniscus around a gold wire immersed in an electrolyte when supplying a square wave voltage are considered. We show that in situ etching current kinetics allows one to improve a yield of tips with a well-defined geometry up to 95% by filtering these on the basis of a cutoff current and a power spectrum of etching current fluctuations. As a quantitative measure for estimating the yield we introduce a probability to find tips with curvature radii falling in the range of interest. Testing the tips for a plasmonic effect is implemented with tip-enhanced Raman spectroscopy and sub-wavelength imaging of a thin fullerene film.

http://dx.doi.org/10.1088/0957-4484/22/2/025202